A Review of Actuarial Principles and the Valuation Process

The California State Teachers' Retirement System has its actuary prepare an actuarial valuation as of June 30 of each odd-numbered year. Historically, this valuation has only been concerned with the Defined Benefit Program administered by CalSTRS. Since June 30, 1997, however, the Cash Balance Benefit Program has also been subject to an actuarial valuation.

The Defined Benefit Supplement Program will be subject to an actuarial review as of June 30, 2001.

Since there tends to be some confusion and mystery surrounding actuarial results and valuation reports, the intent of this discussion is to try to make the process and the results more meaningful and useful. While most of the discussion will focus on the much larger DB Program, these issues and concepts are generally equally applicable to the CB Benefit Program.

Actuarial Liabilities

Actuarial liabilities are created by a promise to pay a specified benefit if certain events occur or certain conditions are met. Actuarial liabilities are not the same thing as accounting liabilities. For an accounting liability, the only question is generally "when." For an actuarial liability, on the other hand, the question is not only "when," but also "if," and "how much." Actuarial liabilities are therefore said to be "contingent." This means they are dependent upon one of several possible events occurring.

To evaluate the potential actuarial liabilities, the actuary must make three estimates:

- if a benefit will start,
- when that benefit will begin, and
- what the benefit amount will be

Money is paid out of the retirement system if one of four events occur: death, termination, disability or retirement.

The amount of any benefit that is to be paid generally depends upon both current and future service and on the extent of future pay increases.

While the system is waiting to pay the benefit, it invests its funds and it earns investment income to supplement contributions that are made by teachers, their employers and the state. To evaluate the plan's potential liabilities, the actuary studies the system's experience and recommends certain assumptions to the Board. The assumptions are split between demographic (or noneconomic) assumptions and economic assumptions.

There are four demographic assumptions for active members: death, termination, disability, and retirement. For retired members and survivors, the only assumption is the likelihood of death. For disabled members, the demographic assumption covers both death and recovery from disability.

There are also four economic assumptions. These are the assumed inflation rate, the salary scale, the investment return assumption and the payroll growth rate.

The Concept of Actuarial Cost

Over the long term, the employers' cost of the plan is going to be equal to the difference between the sum of benefits, refunds and expenses paid out over the sum of employee contributions and investment earnings. Because contributions of the state, employers and members remain constant from year to year and are set by law, poorer investment returns will either decrease the current actuarial surplus or create an unfunded liability. Conversely, greater investment returns will increase the current actuarial surplus.

In order to properly pre-fund a defined benefit plan, it is necessary to determine the appropriate amount of employer and state contributions to be made to the plan. This is the function of an actuarial cost method. The goal of an actuarial cost method is to produce a pattern of contributions that meet the goal and requirements of a defined benefit plan.

There are two components to the actuarial cost of an existing benefit structure or from adding a benefit enhancement. These are the "normal cost" and the amortization charge for funding the unfunded actuarial obligation. The unfunded actuarial obligation is usually referred to as the:

- UL or unfunded liability
- UAAL or unfunded actuarial accrued liability,
- UAL or unfunded accrued liability

The number of years that it will take the current contribution schedule to fully amortize the unfunded liability is referred to as the plan's "funding period."

The normal cost may be thought of as the ongoing cost of the plan, if there were no unfunded liability. It is the annual cost for the benefits that will be earned by the average new entrant over his/her career, if the actuarial assumptions are exactly met and if there is no change in the benefit level.

The amortization charge for the UAAL is the annual rate that this unfunded liability is being paid off, or "funded."

The technical definition of the UAAL depends on the specific actuarial cost method utilized in the valuation. Different cost methods assign different parts of the total actuarial liability for all future benefits to past years (the actuarial accrued liability), to the current year (the normal cost), and the future years (future normal cost). In a way, this is similar to the existence of different inventory evaluation methods in accounting (for example, LIFO or FIFO).

Different actuarial cost methods spread the incidence of actuarial cost in different ways. One approach is to spread cost on the basis of the benefit formula itself (the projected credit unit method). Another approach spreads the incidence of cost on a level dollar basis. Others spread the cost on a level percentage of payroll basis. There is even one method (the aggregate valuation method) that does not create any unfunded liability at all.

CalSTRS uses the entry age actuarial cost method for valuing the DB and DBS Programs. This is the most common method used for public plans. Its popularity is due to the fact that it spreads the cost as a level percentage of pay, and therefore it does the best job of creating equitable treatment among successive generations of taxpayers.

The CB Benefit Program used the traditional unit credit cost method. It is a method best suited to the type of plan design evident by the CB Benefit Program.

Unfunded Liability

The unfunded liability is calculated as the actuarial present value of all future benefits less the actuarial present value of all future normal costs less the current actuarial value of assets. The resulting unfunded liability may either be positive (underfunded) or negative (overfunded).

The unfunded liability is not an accounting liability. It is also not the actuarial liability if the plan is terminated or frozen.

The unfunded liability is the actuarial liability associated with prior years under the entry age cost method, assuming that the plan will continue into the future. It reflects expected future pay increases for current members and expected future service for those members.

There are many reasons why a retirement plan like the CalSTRS DB Program may have ended a prior year with an unfunded liability. As was the situation in CalSTRS' case, a part of the unfunded liability is due to those years in which the full actuarial cost was not contributed, i.e., the years before Elder Full Funding. Unfunded liability can also be created by plan improvements such as increases in the multiplier and retiree benefit increases.

Actuarial gains and losses will also affect the unfunded liability. Gains and losses represent the difference between the actual experience of the plan and the plan's assumed experience. The most dramatic example of actuarial gains during the years 1995-1999 has been the very favorable investment performance achieved by the plan.

Changes in actuarial assumptions and/or methods also affect the unfunded liability. Such was the case for CalSTRS as a result of the last experience study.

It is important to remember that the creation of an unfunded liability is a natural by-product of the entry age methodology. Whenever benefit improvements are granted, the entry age method will cause an increase in the UAAL.

There is nothing wrong or bad about having an unfunded liability. What is important is whether or not the plan is making systematic progress in amortizing that unfunded liability over a reasonable period of time. There is also nothing wrong with a benefit enhancement that increases the unfunded liability, as long as that benefit enhancement is properly funded to begin with.

If, however, the Board sees a consistent pattern of actuarial experience losses from one year to the next, they should have their actuary perform an experience study to determine whether or not the current assumptions need adjustment.

In addition, if they see a consistent pattern of deterioration in the funded level of the plan, they need to begin an education process to alert the Legislature and plan members to the potential dangers of underfunding the plan. The creation of Elder Full Funding is an example of this course of action.

Actuarial Assumptions

Because of the long time horizon of a DB Plan, actuarial assumptions are necessary. The actuary's role is to study and recommend actuarial assumptions. The Board then accepts, rejects, or modifies those recommendations. This action represents a fiduciary decision on the part of the Board.

If the Board and the actuary are too optimistic in establishing the assumptions, the long-term ability of the plan to meet its emerging liabilities may be impaired. Consider two examples:

In the first example, let's say that the Board assumes that the plan will earn 9.5 percent, but in reality the plan only averages 8 percent in investment return. The true value of the liabilities will be greater than what is being assumed in the actuarial valuation process since the actual return is less than expected. This means that more money will be required to pay the benefits than planned on. Therefore, over the long-term the system may have problems paying its benefits in the future.

As a second example, let's say that the Board sets retirement rates to assume that members will retire on average at age 63. In reality, let's say that they actually retire at age 60. While the benefit may be less for retirement at age 60 than at age 63, it is payable for more years into the future. In addition, and maybe even more significantly, the plan has lost three years of contributions that it was counting on receiving.

Because the setting of the assumptions is so critical, the following discussion outlines the nature and impact of each major assumption.

Mortality Assumptions

The active member mortality assumption is not a major actuarial assumption as it relates to the size of the actuarial liabilities. This may be illustrated by comparing the size of the active member mortality rates versus the withdrawal and retirement rates. It is also illustrated by the size of the active-member death benefit liability compared to the retirement benefit liability. The 1999 valuation of CalSTRS showed the following present value of future benefits for active member death benefits versus retirement benefits ($ millions).

Type of Benefit	Active Member	Retired Member
Active member death benefits	$903	$1,670
Present value of future retirement benefits for current active members	$80,793	$31,349

In contrast to the active member mortality assumption, retired member mortality is a major assumption in determining the overall actuarial condition of the plan. The longer the life expectancy in retirement, the longer benefits will be paid. From the plan's viewpoint, favorable experience would occur if there are more deaths among retirees than expected. This is because not as many benefits are being paid out as anticipated being paid out. Therefore the unfunded liability will not grow as fast as assumed.

Rates of Disability

As with the active member mortality assumption, the assumption as to rates of disability is not a major actuarial assumption. Again this may be seen by comparing the size of the disability rates versus the size of the withdrawal and retirement rates. Using the 1999 valuation results, the relative importance of the benefit is seen if the present value of future benefits for future disabilities is compared to the present value of future retirement benefits:

Type of Benefit	Active Member Benefit
Disabled	$ 1,932
Retired	$80,793

In general, fewer disabilities than expected would be viewed as favorable experience. If actual experience exhibits fewer disabilities than expected, then not as many disability benefits will be paid out as anticipated by the unfunded liability.

Withdrawal Rates

The assumption as to withdrawal rates is a major actuarial assumption. It determines the likelihood of members staying in service to draw a retirement benefit. Favorable experience relative to withdrawal rates would be more terminations than expected by the assumptions. If there are more terminations, there will not be as many retirement benefits actually paid as expected and the benefits that are paid will not be as large as expected.

For CalSTRS, the withdrawal rates are a function of both age and service. This type of structure of assumptions is known as "select and ultimate rates." This structure reflects the fact that both age and service affect the likelihood of staying in active employment.

Retirement Rates

The assumption as to retirement rates is also a major actuarial assumption in the valuation process. This assumption determines when the retirement benefits are expected to become payable. Favorable experience would occur if there are fewer retirements than expected. In this scenario, CalSTRS has its funds longer than expected, it gets its contributions longer than expected, and it pays out benefits for fewer years than expected.

Disabled Life Mortality

The mortality assumption for disabled lives is not a major actuarial assumption. This is due to the size of disabled life liabilities compared to retired life liabilities.

Favorable experience would occur if there are more deaths or recoveries than expected by the assumption. This would mean that not as many disability benefits are being paid out relative to the assumed pay out.

Inflation Assumption

The inflation assumption is a key economic assumption. It is not, however, affected by CalSTRS experience.

The importance of this assumption is that it links the assets and the liabilities. This is because it is a component of both the salary scale and the investment return assumption. The current CalSTRS assumption for inflation is 3.5 percent.

Salary Scale Assumption

The salary scale assumption is a major assumption from an actuarial standpoint. It helps determine the amount of the expected benefits to be paid by CalSTRS.

Favorable experience occurs when salaries go up slower than expected, producing smaller actual benefits than anticipated by the actuarial calculations. Salary gains have been common in many state retirement systems over the last few years.

There are three components to the salary scale. The first component is inflation. The second component is the productivity component. This component measures how much general salary increases exceed inflation. This is over and above any age- or service-related salary increases.

The final component of the salary scale is the promotional component. For CalSTRS, it is a function of both age and service. It reflects increases in the salary schedule that occur due to an additional year of service or experience. It also reflects the adjustment that occurs in salary for additional degrees or for promotions.

Currently, the salary scale for CalSTRS includes the inflation component of 3.50 percent, a productivity component of .75 percent, and a promotional component that is a function of age and service and ranges from .8 percent to 6.1 percent.

Investment Return Assumption

The investment return assumption is the most visible actuarial assumption and, needless to say, it is a major assumption. It determines the discounted value of future benefits, and it determines how fast assets are expected to accumulate through the investment process.

It should come as no surprise to state that favorable experience relative to this assumption occurs when the invested assets earn a higher rate of return than expected. This would be illustrated by the investment performance that has been achieved during the plan years since 1995.

There are two components to the investment return assumption. Like the salary scale assumption, the first component is inflation. This component is not affected by the plan's asset allocation. The second component is the real rate of return net of investment expenses. This assumption is affected by asset allocation, market forces, and manager performance.

The current investment return assumption for CalSTRS is 8 percent. This is the most common rate used by large public plans. Because the inflation component is 3.50 percent, this means that the current real rate of return assumption is 4.50 percent, net of investment expenses.

If the inflation component is changed and there is no change in the expected real rate of return, the amount of the change will be equal to the change in the inflation assumption. If, on the other hand, the inflation component is changed, but there is no change in the total (nominal) investment return assumption, this implies that there has been an increase in the assumed real rate of return. The increase in the assumed real rate of return will equal the decrease in the inflation assumption.

Because of the common inflation component in these two assumptions, changes in the salary scale and the investment return assumptions should be viewed together to evaluate their reasonableness. The linkage of these two elements may be analyzed in an asset/liability modeling study.

The Actuarial Valuation

The primary purpose of the actuarial valuation for the CalSTRS DB Program is to determine the adequacy of the current contribution structure. This adequacy is measured in terms of the funding period. There are, however, several other purposes of the valuation. These include:

- Tracing the change in the funding period from the last valuation to the current valuation.

- Calculating the actuarial gains and losses for the two-year period between valuations.
- Providing a biennial snapshot of the status of the plan.

For the Cash Balance Benefit Program, the valuation process evaluates how the plan net assets match-up with the sum of the nominal account balances, the Gain and Loss Reserve, and any Annuitant Reserve. It also determines how to allocate that year's investment earnings among minimum interest credits, additional earnings credits, additional annuity credits, and the Gain and Loss Reserve.

As with everything the CalSTRS actuary does, all results in these valuations are based on the assumptions and methods adopted by the Board.

A great deal of information is derived from the valuation report. As noted above, the primary focus of the DB valuation is to determine the funding period for amortizing the unfunded liability, based on the current contribution schedule.

The valuation will also provide information on any assets and/or liability gains or losses, the size of the unfunded liability itself, the plan's current funded status, an estimate of investment returns based on the actuarial value of assets, numerous member statistics, and the external cash flow during the two-year period.

How to View and Interpret Valuation Results

A number of issues contribute to the perception that actuarial concepts are difficult to understand. These include the long-term nature of the actuarial liabilities themselves. It also reflects the large number of actuarial variables that are present in the valuation. Yet another complicating feature is the existence of complex benefit provisions.

The valuation report contains a multitude of numbers and amounts. In trying to understand the significance of the valuation, readers of the report should not just focus on the numbers in isolation.

In order to understand the meaning of the valuation results, it is helpful to put the actuarial results in perspective by looking at trends and comparisons:

- Is the funded ratio changing from year to year? If so, is it increasing or decreasing from one valuation to the next?
- Is the unfunded liability growing or declining as a percent of payroll? The unfunded liability may be increasing in total dollar amount simply because the active membership is growing. By looking at it relative to payroll, it is possible to evaluate whether or not the unfunded liability is growing faster or slower than the system as a whole.
- It is important to observe any pattern of actuarial gains or losses from one valuation to the next. If there are changes in the unfunded liability, can those changes be explained by benefit enhancements or by changes, in assumptions?
- Is the funding period increasing or decreasing from one valuation to the next?

These are the types of reviews and analysis that the actuary performs when evaluating the valuation results.

Concluding Remarks

While the technical meaning of the numbers and terms can be very imposing in an actuarial valuation, it is possible to gain understanding by focusing more on trends and patterns rather than the individual numbers themselves.